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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
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09/160,965 09/25/98 SHUE

S TSMC97-542/9

GEORGE O SAILE
20 MCINTOSH DRIVE
POUGHKEEPSIE NY 12603

MM91/0911

EXAMINER

KIELIN, E

ART UNIT

PAPER NUMBER

2813

DATE MAILED:

09/11/01

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

Office Action Summary

Application No.
09/160,965

Applicant(s)
Shue et al.

Examiner
Erik Kielin

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2813



-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on Aug 8, 2001.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1, 2, 4, 6, and 10-12 is/are pending in the application.
- 4a) Of the above, claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1, 2, 4, 6, and 10-12 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claims _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are objected to by the Examiner.
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

- 13) ☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).
- a) ☐ All b) ☐ Some* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- *See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

- 15) ☐ Notice of References Cited (PTO-892)
- 16) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 17) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s). _____
- 18) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 19) ☐ Notice of Informal Patent Application (PTO-152)
- 20) ☐ Other:

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DETAILED ACTION

Request for Continued Examination

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 8/8/01 has been entered.

Drawings

2. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the "cap layer" of independent claim 1 must be shown must be shown or the feature(s) canceled from the claim(s). **No new matter should be entered.**

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person

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having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 1-2, and 4, 6, 10-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Lin** (US 6,093,656) in view of **Rathore et al.** (US 6,069,068) and **Datta et al.** (US 5,567,300)

Lin discloses the silicon substrate 12, the damascene trenches 13, 14 in a dielectric layer, the barrier metal layer (column 3, lines 17-23); the copper layer 20 (or “conductor,” claim 1); the reverse tone photoresist mask 26 which covers the copper in the trenches (column 3, lines 32-57; Fig. 3); etching the exposed copper portions down to the silicon using a wet etch (Fig. 4; column 4, lines 15-21); stripping the photoresist (column 4, lines 22-25); planarizing the copper by CMP (column 4, lines 27-29). See also columns 1-4 and all figures.

Lin does not (1) specifically use the terminology, “dual damascene” or show a dual damascene structure in the figures, (2) does not specifically state that the disclosed “blanket copper deposition” (column 3, line 24) is electroplating on a seed layer; (3) reverse current electroplating; or (4) the cap layer.

Regarding (1), aside from it being known in the art that dual damascene (as opposed to single damascene) is also subject to dishing during metal planarization and for the same reasons, **Lin**’s claim 1 indicates the damascene, dielectric trenches have “at least two levels of elevation.” A third level of elevation would clearly yield a dual damascene trench structure. Therefore, **Lin** implicitly defines the invention for dual damascene. Note that it has been held that “[I]n considering the disclosure of a reference, it is proper to take into account not only specific

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teachings of the reference but also the inferences which one skilled in the art would reasonably be expected to draw therefrom.” *In re Preda*, 401 F.2d 825, 826, 159 USPQ 342, 344 (CCPA 1968) See also *In re Lamberti*, 545 F.2d 747, 750, 192 USPQ 278, 280 (CCPA 1976). Therefore, dual damascene is at least implicitly disclosed as being incorporated both in Lin’s inclusive claim language and in that fact that dual damascene is notoriously well known in the art, especially as defined in the Lin claims.

Regarding (2) and (4), although **Lin** does not specifically state electroplating is used for filling, **Lin** does teach that the blanket deposition of copper “could be done in a number of different ways...” (column 3, lines 23-27). **Rathore** teaches that it is known in the art to fill a dual damascene pattern using electroplating of copper on the stack consisting of adhesive layer 5, barrier layer 6, and seed layer 8 followed by planarization of the electroplated copper layer 9 and said stack (column 2, lines 45-59; Fig. 1a) and finally depositing a cap layer 7, 10 to seal the copper. (See Figs. 6b-6d.) Note also the **Rathore** states that “electroplating of copper **requires** a copper seed layer” (column 2, lines 3-5; emphasis added).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use any conventional copper electroplating on a required seed layer for the reason given in **Lin** because **Lin** teaches blanket depositing which clearly indicates to one of ordinary skill that **any** blanket depositing method is appropriate, such as the electroplating of **Rathore**.

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use the cap layer for the reasons indicated in **Rathore**.

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Regarding (3), **Datta** et al. and references cited therein teaches the benefits of reverse current electroplating for the purpose of removing unwanted metal -- particularly copper -- regions for the purpose of planarizing (sections entitled “Planarization is desirable for two reasons” and “There are various planarization methods ”).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify **Lin** in view of **Datta** for the reasons given in **Datta**.

Regarding claim 4, in claim 1 of **Lin**, the layer 20 is limited to only “conductors” and therefore makes the use of any of Applicant’s claimed conductors obvious. It has been held that selection of a known material based on its suitability for its intended use is *prima facie* obvious.

Regarding claim 6, **Lin** does not indicate that the dielectric is silicon oxide, but it is known to use silicon oxide for the dielectric in damascene processes and is therefore obvious to one of ordinary skill to use as a matter of routine material choice. See *Sinclair & Carroll Co., Inc. v. Interchemical Corp.* , 325 U.S. 327, 65 USPQ 297 (1945). See also *In re LESHIN*, 125 USPQ 416 (CCPA 1960). The choice of silicon oxide for **Lin**’s dielectric; Au, Al, with, Ti, or Ag for **Lin**’s conductor; and are obvious as amounting obvious material choice, well within the purview of those of ordinary skill, as per the precedent above.

Regarding claims 11-12, **Lin** makes clear the inherency of or alternatively suggests Applicant’s “critical dimensions” in **Lin**’s discussion of the reverse tone photoresist mask. The choice of critical dimensions is obvious as a matter of routine optimization. These claims are *prima facie* obvious without showing that the claimed ranges achieve unexpected results relative

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to the prior art range. *In re Woodruff*, 16 USPQ2d 1935, 1937 (Fed. Cir. 1990). See *In re Aller*, 105 USPQ 233 (CCPA 1955) (selection of optimum ranges within prior art general conditions is obvious).

Response to Arguments

5. Applicant's arguments filed 8/8/01 have been fully considered but they are not persuasive.

Applicant is separately arguing the references of Lin and Datta. The deficiencies at taught, suggested or known in the art as indicated above, and the combination is proper as indicated in a previous action.

The remainder of the arguments are moot in view of the new grounds of rejection.

Conclusion

6. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Fiordalice et al., US 5,578,523, at column 1, line 59 to column 2, line 27, teaches that the causes of dishing in single damascene are the same as those in dual damascene.

Bernhardt et al. (US 5,256,565) teaches reverse current electroplating to planarize damascene copper electroplated onto a seed layer.

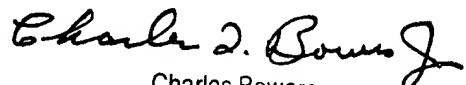
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7. Any inquiry concerning this communication from examiner should be directed to Erik Kielin whose telephone number is (703) 306-5980 and e-mail address is erik.kielin@uspto.gov. The examiner can normally be reached by telephone on Monday through Thursday 9:00 AM until 7:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Charles Bowers, can be reached at (703) 308-2417 or by e-mail at charles.bowers@uspto.gov. The fax phone number for the group is (703) 308-7722 or -7724.

EK
EK

August 31, 2001


Charles Bowers
Supervisory Patent Examiner
Technology Center 2800